National Aeronautics and
Space Administration

FY 1993
SAFETY PROGRAM
STATUS REPORT

NASA Safety and Risk Management Division
Office of Safety and Mission Assurance
Washington, D.C. 20546

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SAFETY PROGRAM OVERVIEW

During FY 1993, the NASA Safety and Risk Management Division continued efforts to enhance the quality and productivity of its safety oversight function. Initiatives in areas such as training, risk management, safety assurance, operational safety, and safety information systems have contributed to the safety and success of activities throughout the Agency.

The Safety and Risk Management Division continued to sponsor development of a centralized intra-agency safety training program. A major accomplishment in this area is the continued success of the NASA Safety Training Center (NSTC). This facility is located at the Johnson Space Flight Center (JSC) and provides quality NASA-specific safety training at lower cost. The NSTC trained over 1,100 students in FY 1993 on a broad range of safety-related topics including: safety management, safety engineering, occupational health and safety, fire protection, explosives safety, construction safety, laboratory safety and health, ergonomics, and mishap investigation.

The Safety and Risk Management Division sponsored a number of safety related research and development activities conducted at Headquarters and various NASA Centers. There were efforts to improve and expand NASA's assurance information systems. Development of a Lessons Learned Information System was completed. The software was made available throughout NASA and the Department of Defense and training sessions on the system were held. This automated data base will be a valuable tool for use by safety personnel, program managers, and engineers to help avoid costly mistakes by allowing easy access to information on the experiences of others. An upgraded prototype of an automated NASA Safety Training Catalog was completed and tested in FY 1993. This data base will provide NASA and contractor personnel instant access to information on safety-related courses available throughout the Agency. A working prototype of a NASA lifting device data base also was completed at the Stennis Space Center (SSC) in FY 1993. Copies of the software were distributed to all NASA Centers for their review and comment. The final release is scheduled for FY 1994. The intent is to establish a method of tracking and retaining pertinent data relating to the safe operation of lifting devices. The data base will be used by safety and engineering personnel throughout NASA for historical and trend analysis purposes to determine equipment reliability and establish preventive maintenance requirements.

The Lewis Research (LeRC) Center is developing a Process Safety Management Program in compliance with new Occupational Safety and Health Administration (OSHA) regulations. Program documentation (standards, operating procedures, etc.) will provide the basis for an Agencywide program. The Goddard Space Flight Center (GSFC) is conducting a research program to develop effective fire protection for high bay structures. FY 1993 activities included the study of smoke movement and smoke layer development in high bays. GSFC is also developing a Facility System Safety Handbook to provide comprehensive procedures for standardized facility system safety engineering techniques to be used throughout NASA. Ames Research Center (ARC) and SSC are working jointly to develop an aerial reconnaissance system that would provide responsible officials with real-time damage assessment data in the event of an emergency/disaster. This effort is being coordinated with the Federal Emergency Management Agency (FEMA). The goal is to utilize NASA technology to meet a critical national need for rapid-response disaster assessment.

NASA continued to work with the Air Force on a joint test and evaluation program for graphite/epoxy composite overwrapped pressure vessels. This relatively new technology is becoming more widely used in the aerospace industry due to the potential for weight savings. There are a number of unique safety concerns for personnel working with and around these vessels. The purpose of the research program is to better define the design, handling, and transportation requirements necessary to use these vessels safely.

NASA continued its initiatives to control trends, major causes or sources of fatalities and lost time disabilities, and to lower overall compensation costs. The Safety and Risk Management Division sets annual lost time injury/illness frequency rate goals for each Center. The goals are based on a number of parameters including previous performance as compared to the Center's own past record and to the overall Agency rate, improvement desired, and projected worker hours. This effort is part of an overall safety motivation program that strives to continually reduce injuries in the workplace. The outstanding efforts by all NASA personnel during FY 1993 resulted in one of the lowest lost time injury/illness rates in recent history.

The Safety and Risk Management Division continued its participation with the Federal Advisory Committee for Occupational Safety and Health (FACOSH) to ensure NASA remains abreast of all new regulations, initiatives, issues, etc. NASA worked closely with the FACOSH Training Subcommittee to solve the problem of providing effective training to employees at reasonable cost. FY 1993 saw the first full implementation of NASA's agreement with OSHA that allows OSHA training courses to be presented by the NASA Safety Training Center (NSTC). OSHA 501, "A Guide to Voluntary Compliance," was successfully presented to 175 students over NASA's Video Teleconference System (ViTS). The NSTC coupled with NASA's ViTS has proven to be a powerful combination for providing high quality training to large numbers of students in a most cost-effective manner. NASA training courses will be made available to other government organizations with similar training needs.

JSC has initiated a pilot program to participate in the OSHA Voluntary Protection Program (VPP). JSC conducted a thorough review of their safety and health program, and based on the findings, refinements are being made to qualify for VPP participation.

A major accomplishment for FY 1993 was OSHA's approval of NASA's new Safety Standard for Explosives, Propellants, and Pyrotechnics as a supplementary standard. This document, published in August 1993, defines NASA's policy for the safe use, handling, and storage of explosives, propellants, and pyrotechnics.

NASA participated in the National Highway Traffic Safety Administration Drunk and Drugged Driver Awareness Campaign and subscribed to the Department of Transportation's "Four Seasons Approach" to traffic safety.

The NASA Safety Policy and Requirements Document (formally called the NASA Basic Safety Manual) was completed and published in June 1993. This is the central Agency document containing safety policy and requirements that define the NASA Safety Program. The document was published in looseleaf form and is subject to continuous upgrading and change.

NASA expanded and enhanced its Emergency Preparedness Program. All NASA Centers developed programs designed to address their unique needs and to implement the Agency plan published last year. The Safety and Risk Management Division sponsored an Emergency Preparedness Coordinators meeting at the Kennedy Space Center (KSC), February 1 - 5, 1993. This meeting included an Emergency Information System (EIS) Basic Users Workshop designed to introduce and provide basic user skills for the EIS computerized emergency planning and response tool. The Emergency Preparedness Program purchased two mobile command units during FY 1993. These suitcase-size units include a Notebook PC, facsimile machine, bubble jet printer, cellular phone, hand-held scanner, and video still camera. Upon completion of testing and evaluation, a unit will be purchased for each NASA Center.

The Headquarters Hazardous Substances Internal Coordinating Committee continued to provide a forum for interdisciplinary discussion among all Headquarters staff concerned with the health, safety, storage, and transportation of hazardous materials, and the environmental exposure of the NASA workforce. The committee was active in screening and assessing the impact of new and proposed regulatory requirements and the need for related training.

The NASA Safety and Risk Management Division continued to sponsor periodic Safety Directors' Steering Committee meetings. The meetings provide a forum for the exchange of information and the discussion of safety-related issues. The FY 1993 meeting was held at KSC in conjunction with OSHA's 47th Annual Federal Safety and Health Conference in Orlando, Florida. Mr. Frederick Gregory, NASA Associate Administrator for Safety and Mission Assurance, was a keynote speaker at the OSHA Conference. His presentation covered the intergovernmental cooperation between OSHA and NASA that led to the first approved alternate safety standard for working under a load suspended from a crane.

The Safety and Risk Management Division sponsored a Fire Protection Meeting at KSC, May 25 - 27, 1993, in conjunction with the National Fire Protection Association's Annual Meeting held in Orlando, Florida. The primary topic of the meeting was development of the NASA Safety Standard for Fire Protection. The document was completed and published in August 1993. This standard establishes a uniform, comprehensive NASA Fire Protection Program.

The Safety and Risk Management Division also sponsored a Lifting Device Safety Conference at KSC, June 22 and 23, 1993. The purpose was to discuss implementation of the NASA Safety Standard for Lifting Devices and Equipment, review proposed changes to the document, discuss new lifting safety issues, and maintain a high level of emphasis on NASA's Lifting Device Safety Program.

The Safety and Risk Management Division is actively involved in the design and implementation of NASA's Functional Management Review (FMR) program to ensure proper assessment of NASA's safety programs. A questionnaire based on 29 CFR 1960 and applicable OSHA and NASA safety requirements was developed to assist the Centers with self-assessments of their safety programs.

NASA will continue to strive for maximum safety awareness and excellence in all activities. The Centers and Headquarters will continue to work together as a team to maintain an emphasis on safety.

James D. Lloyd
Director, Safety and Risk Management Division

FY 1993 NASA SAFETY STATISTICS

Fatalities	0
NASA Safety Reportable Lost Time Injuries/Illnesses	81
Costs	
Lost Wages	$169,542
Chargeback Billing	$6,300,000
Material Losses	* $5,384,959
Total Losses	*$11,854,501

* Does not include loss of the Mars Observer spacecraft. The value of Mars Observer (equipment only) is estimated at $250 million. See Page 32 for further details.

Information on injuries/illnesses and material losses was obtained from the NASA Mishap Reporting/Corrective Action System (MR/CAS). Lost wages and chargeback billing figures are from the Office of Workers' Compensation Programs (OWCP).

NASA OCCUPATIONAL INJURY/ILLNESS RECORD

As defined by OSHA, a recordable (i.e., compensable) lost time case is a work-related incident that results in either a nonfatal, traumatic injury that causes loss of time from work or disability beyond the day or shift when the injury occurred, or a nonfatal illness/disease that causes loss of time from work or disability at any time. NASA Safety organizations adhere to the OSHA reporting guidelines with some exceptions. For example, NASA Safety does not consider restricted duty or time taken for medical treatment to be lost time. Also, instances of injuries sustained during recreational activities or in parking lots during non-work-related activities are not included in the MR/CAS.

Table 1 shows the FY 1993 NASA Safety reportable injury/illness statistics for Federal employees at NASA Centers. The NASA Safety and Risk Management Division calculates injury/illness frequency rates based on the actual hours worked by each employee. The overall lost time frequency rate of 0.35 for NASA Federal employees is a 27% decrease from the FY 1992 rate of 0.48.

TABLE 1. NASA SAFETY REPORTABLE LOST TIME INJURIES/ILLNESSES BY INSTALLATION
ANNUAL REPORT FY 1993

	Average No. of Employees	Hours Worked	Lost Time Cases: No. Days	Lost Time Cases: No. Cases	Freq.* Rate	1993 Goal
ARC/DFRF	2,563	4,703,881	160	21	0.89	0.51
GSFC/WFF	3,934	7,128,514	77	10	0.28	0.37
HQ	2,395	4,612,502	77	7	0.30	0.66
JSC/WSTF	3,952	6,565,649	33	9	0.27	0.36
KSC	2,631	4,733,067	82	5	0.21	0.34
LARC	2,962	5,459,665	58	7	0.26	0.35
LERC	2,871	5,257,823	59	8	0.30	0.43
MSFC/MAF	3,664	6,762,664	111	12	0.35	0.39
SSC	224	473,949	2	2	0.84	0.34
NASA	25,196	45,697,714	659	81	0.35	0.40
1992	25,695	47,047,690	945	112	0.48	0.40

* Lost Time frequency rate = Number of lost workday cases per 200,000 hours worked.

Figure 1 shows how the FY 1993 NASA Safety reportable lost time injury/illness frequency rates for Federal employees at NASA Centers compare to the individual Center goals set by the Safety and Risk Management Division, the overall NASA goal of 0.40, and the overall FY 1993 NASA rate of 0.35. NASA met its overall goal for FY 1993 and 7 out of 9 Centers met their individual goal.

Figure 2 plots the NASA Safety reportable lost time frequency rates for the last 10 years. The plot shows a relatively narrow range of rates during this period, from 0.35 to 0.48. The 1993 performance of 0.35 was the best in recent years.

Figure 3 compares the FY 1993 NASA Safety reportable lost time frequency rates of NASA Federal employees at each Center with the previous year's rate and an average rate for the previous 3 years (FY 1990 - FY 1992). 1993 was an outstanding year for 7 out of 9 NASA Centers relative to their recent past performance.

Approximately 99% of NASA's FY 1993 lost time cases were injuries rather than illnesses. See Figure 4 for a breakdown of the major causes of lost time injuries Agencywide for FY 1993. Slips, trips, and falls were the number one cause of lost time injury (48%) followed by overexertion while lifting or moving objects (33%). Figure 5 shows the percentage of lost time injury at each Center attributed to these two causes. Figure 6 provides a breakdown of the injured body parts. Back injuries were the most prevalent. One third of all NASA's FY 1993 lost time injuries were attributed to back injuries.

NASA LOST TIME RATES VS. GOALS
FY 1993

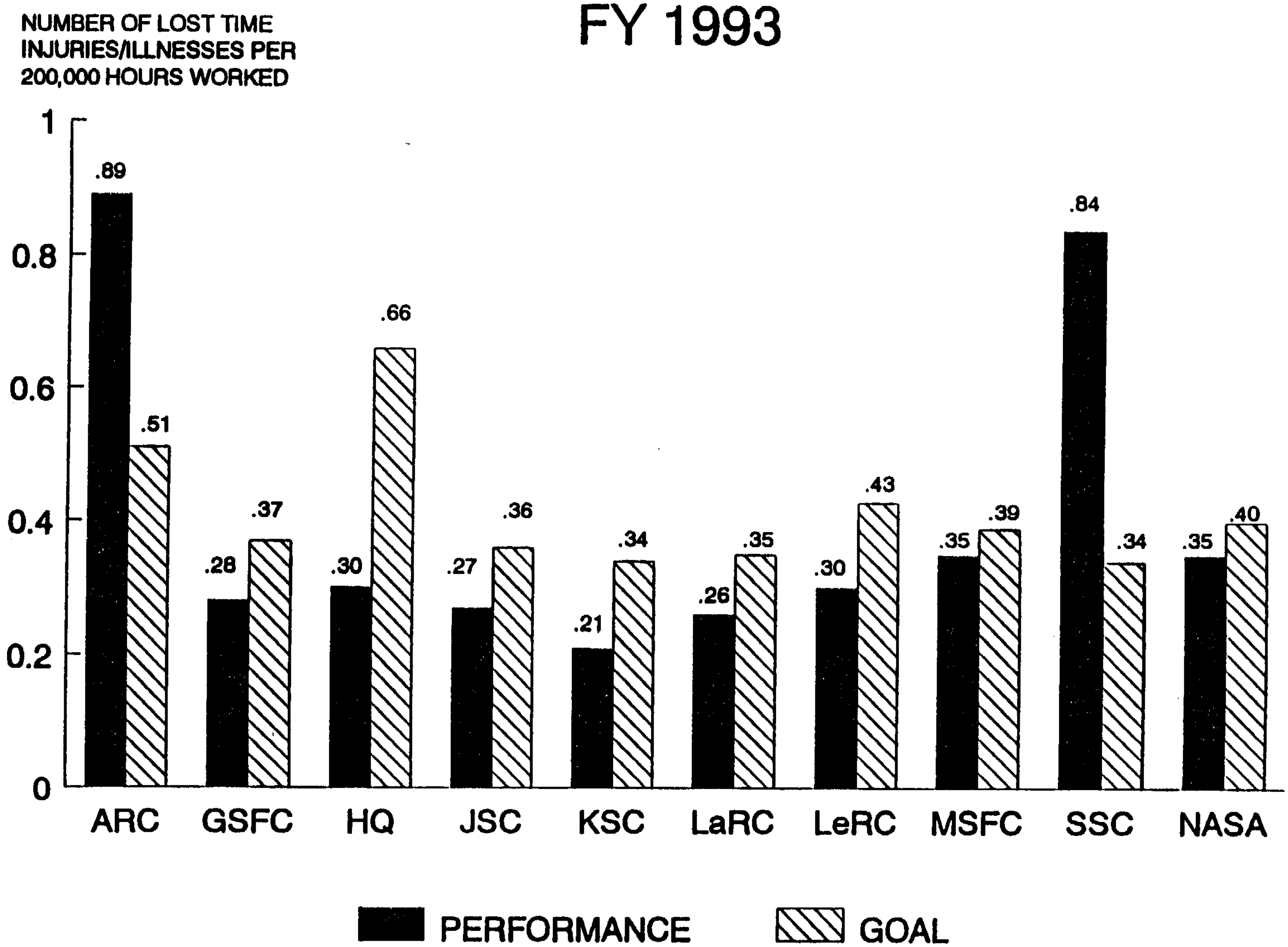


Figure 1

NASA LOST TIME INJURY/ILLNESS RATES

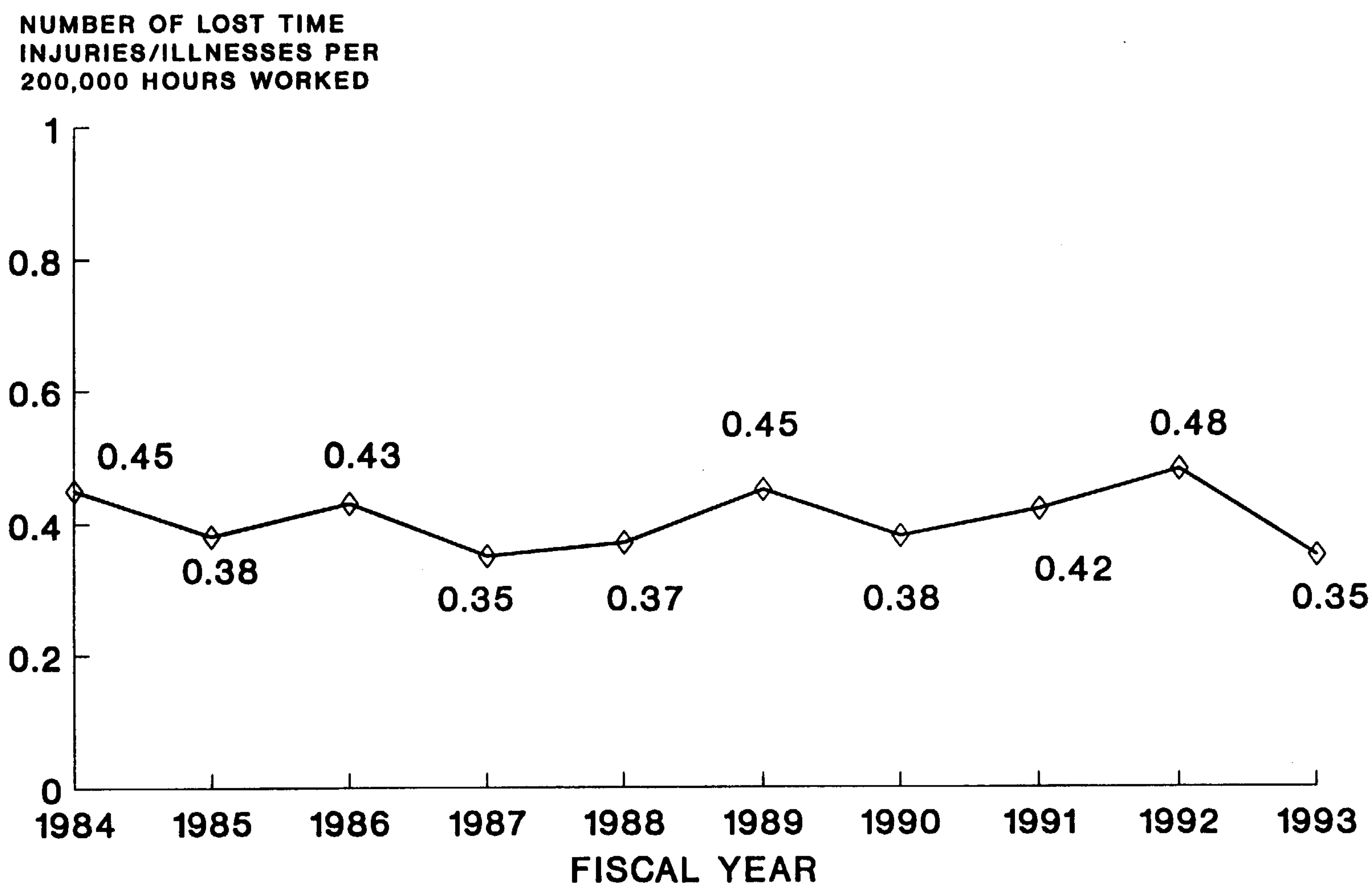


Figure 2

NASA FEDERAL EMPLOYEES
LOST TIME INJURY/ILLNESS RATES

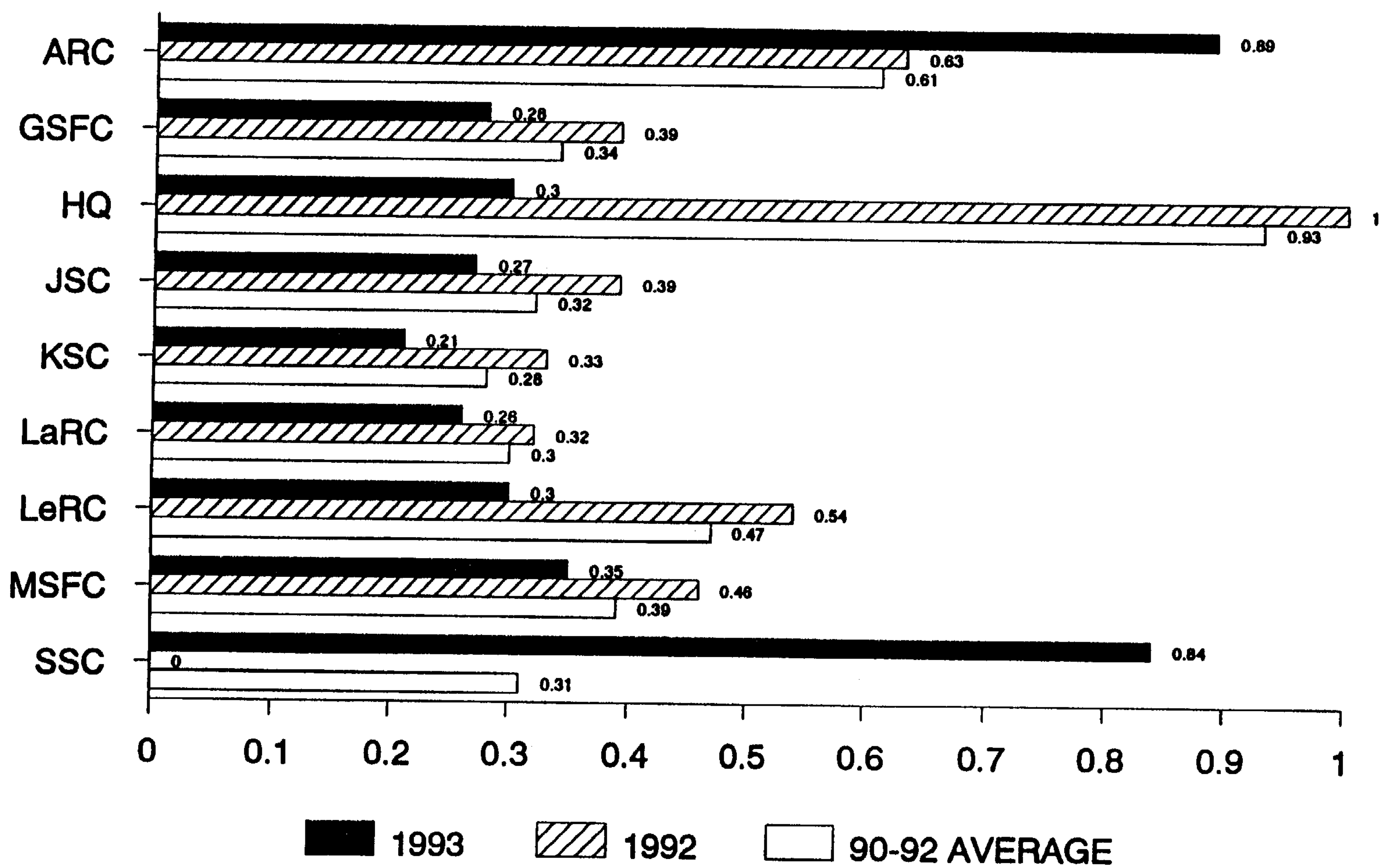


Figure 3

FY 1993 NASA LOST TIME INJURY CAUSES

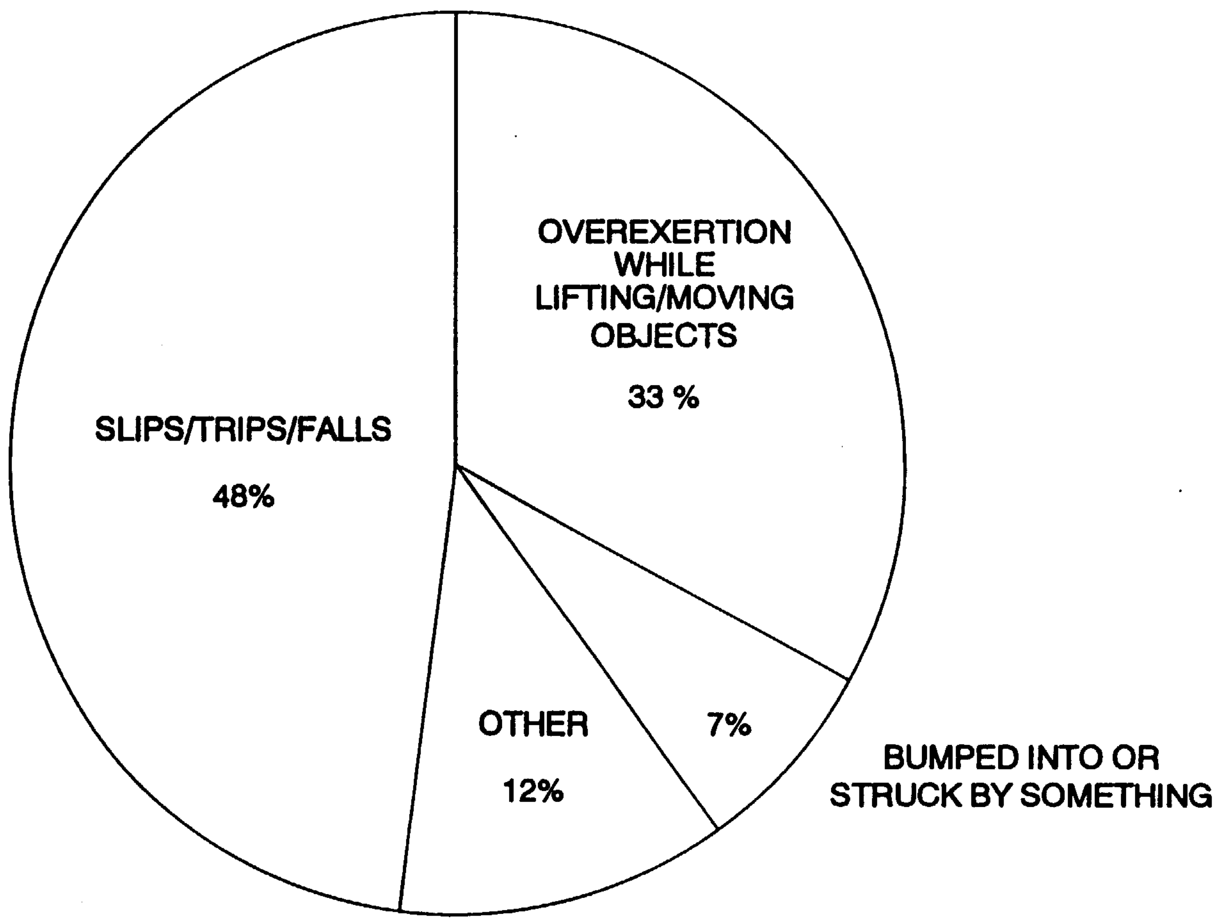


Figure 4

MAJOR CAUSES OF LOST TIME INJURIES AT NASA CENTERS DURING FY 1993

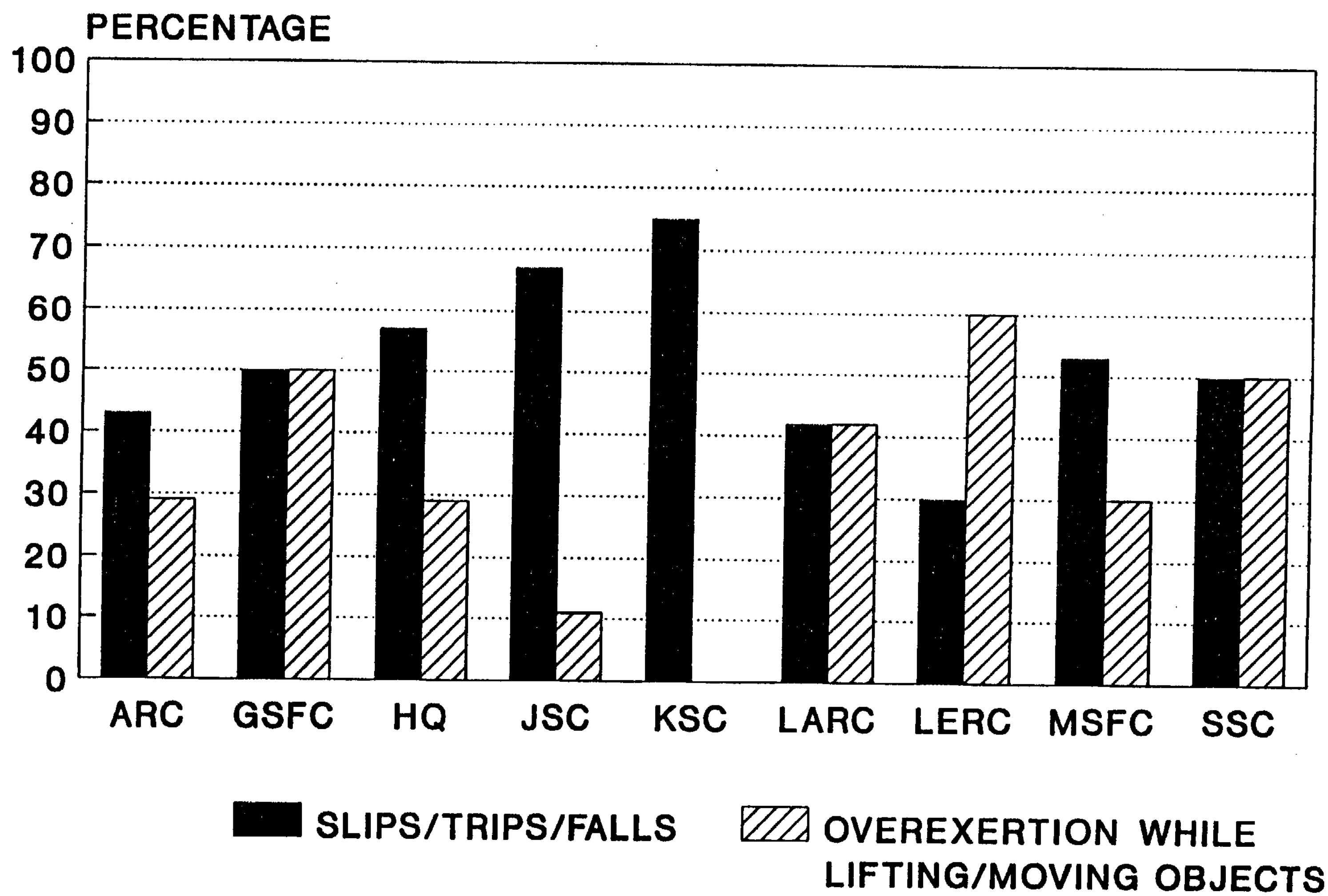


Figure 5

FY 1993 NASA LOST TIME INJURY BODY PARTS AFFECTED

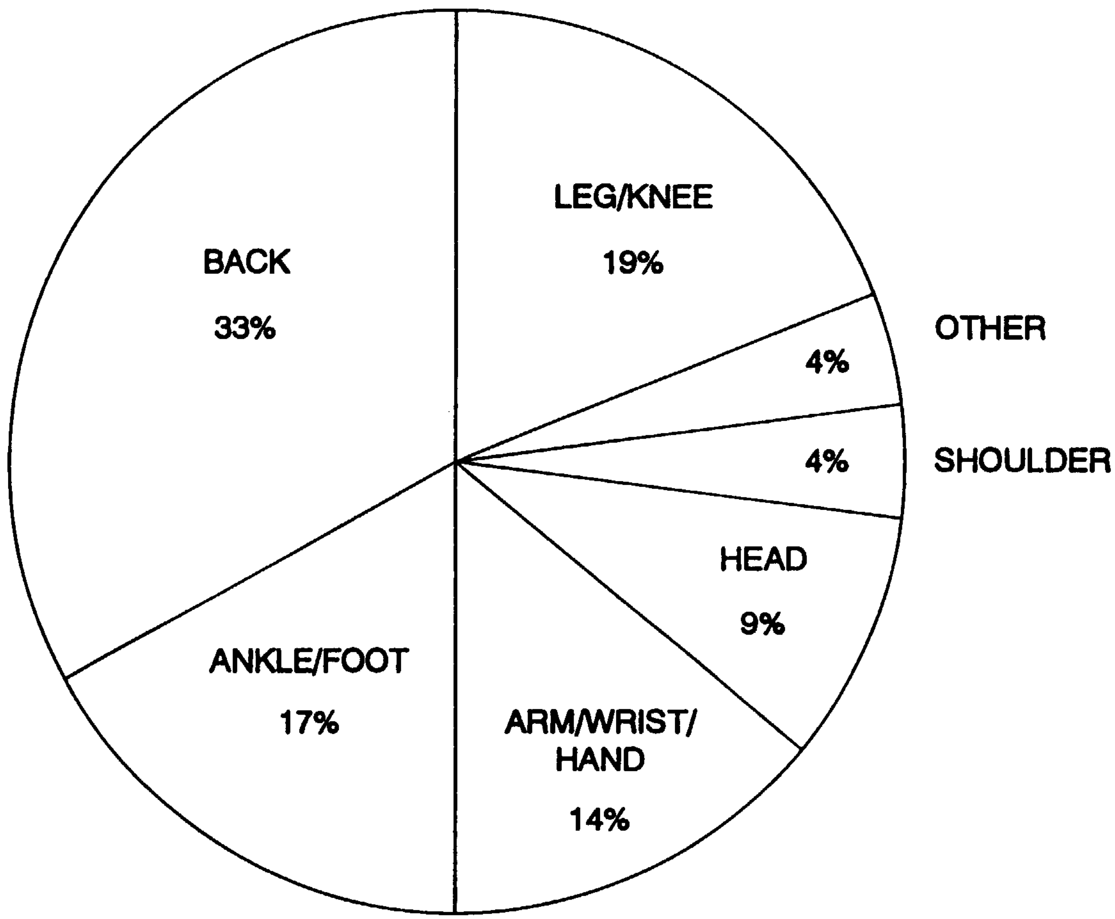


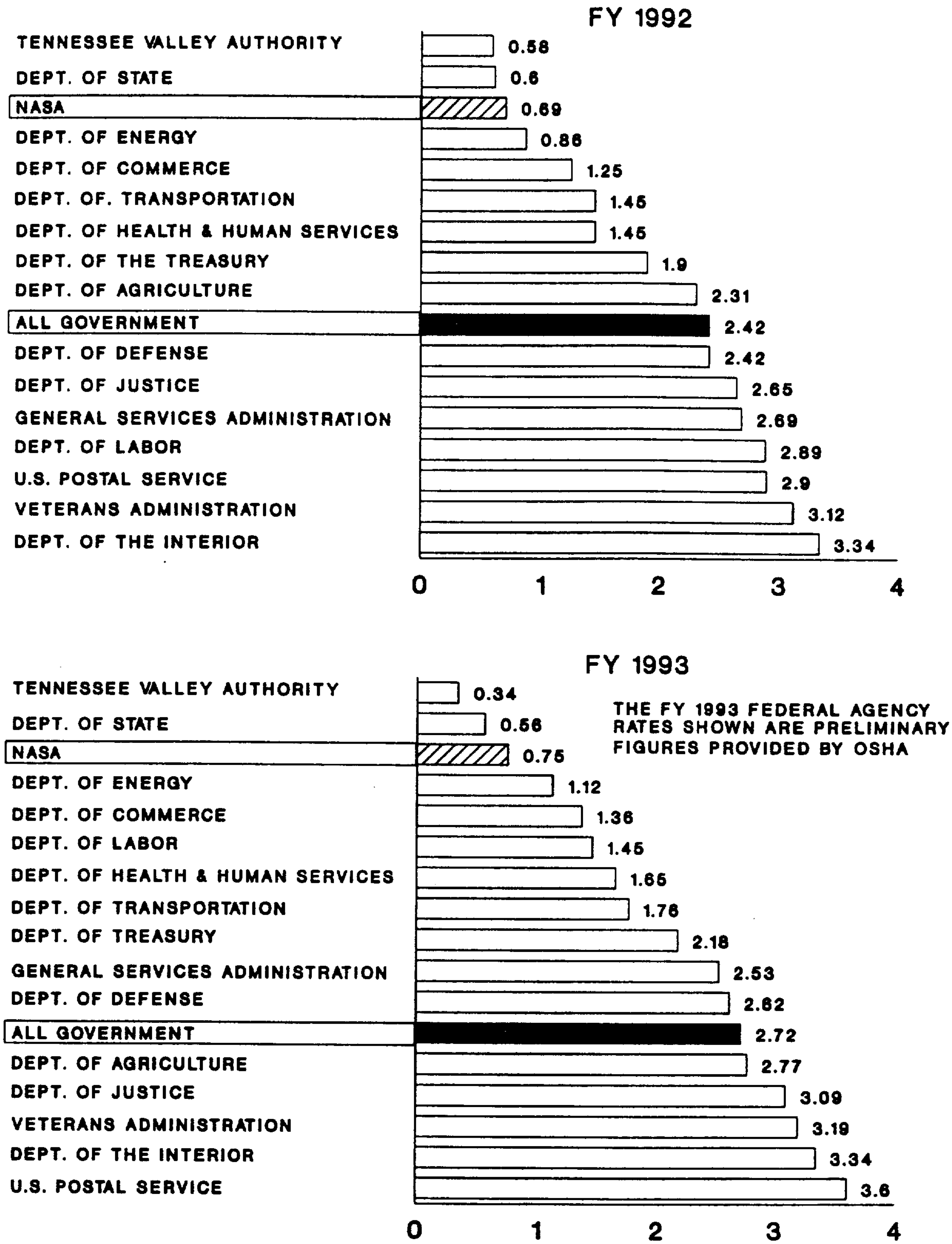
Figure 6

Comparison of NASA's injury/illness performance to that of other Government agencies and private industries can be made using the injury/illness incidence rates published by the Department of Labor. Figures 7 and 8 reflect these rates, which are based on OWCP data and determined according to the number of injury/illness cases per 100 employees. The incidence rate for NASA is usually higher than the frequency rate calculated by the NASA Safety and Risk Management Division. This is due to inherent differences in the two formulas and variations in the OWCP data. (OWCP tracks the number of claims made on OSHA recordable injuries and illnesses. It is possible for more than one claim to be made as the result of a given injury or illness.)

Figure 7 illustrates the relative position of NASA's lost time injury/illness performance compared to that of other Federal agencies having more than 15,000 employees in FY 1992 and FY 1993. Within this group of Federal agencies, NASA ranked second from 1984 to 1991. A significant improvement by the Tennessee Valley Authority resulted in NASA slipping to third in FY 1992 and again in FY 1993.

Figure 8 compares NASA's lost time injury/illness performance for the last 10 years against the total for all Federal agencies and select private sector industries. NASA's rates have been consistently lower than the total for all Federal Government and the private sector. The most recent statistics available from the Department of Labor for the private sector are for FY 1992.

LOST TIME INJURY/ILLNESS RATES IN SELECTED FEDERAL AGENCIES *



* HAVING MORE THAN 15,000 EMPLOYEES.

Figure 7

LOST TIME
OCCUPATIONAL INJURY/ILLNESS RATES
PRIVATE SECTOR-ALL FED. AGENCIES-NASA

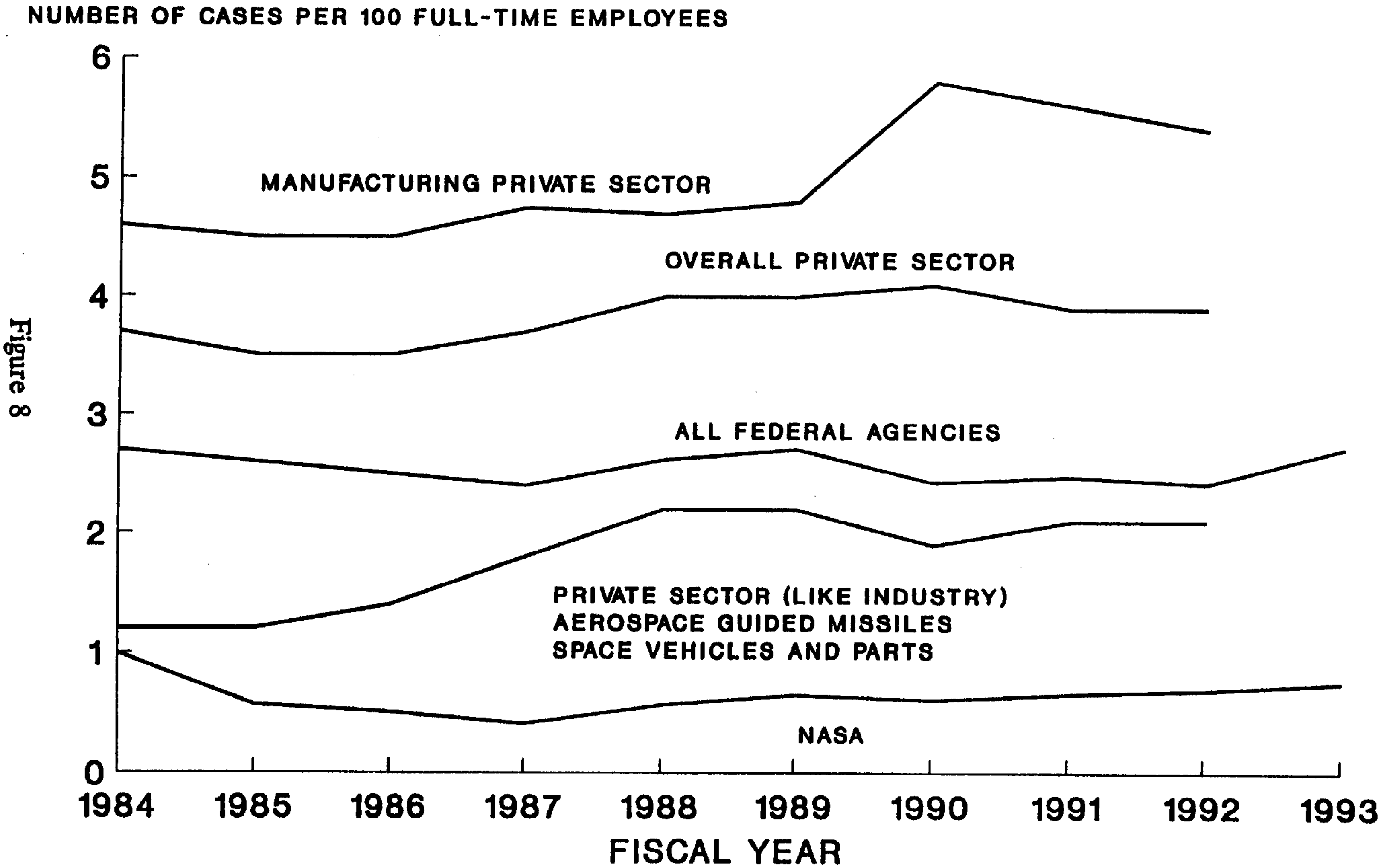


Figure 8

CHARGEBACK BILLING

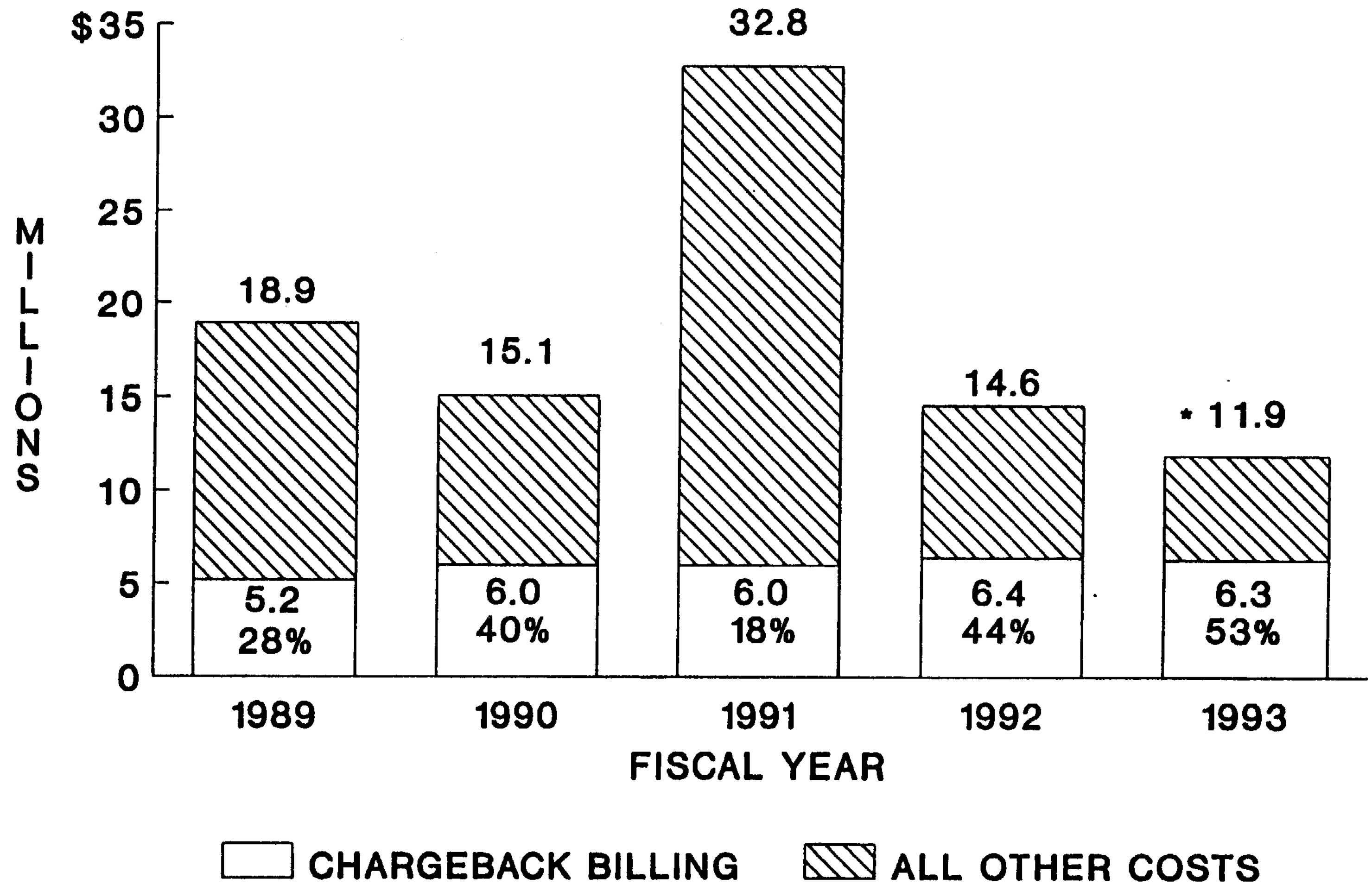
Chargeback is defined by OSHA as a system under which the Department of Labor pays compensation and medical costs attributed to injuries that occurred after December 1, 1960, and then bills the agency that employed the individual who received compensation or benefits. This is a direct loss to NASA's operating budget. In any given year, most of the chargeback billing is a result of illnesses and injuries that occurred in previous years.

Figure 9 presents a 5-year history of NASA's total losses from chargeback billing and all other mishap and injury-related costs. These costs include lost wages (continuation of pay) as well as damage to or loss of NASA property in excess of $1,000. Of the $11.9 million* loss for FY 1993, $6.3 million, or 53%, was paid out in chargeback billing costs.

Figure 10 illustrates the trend of chargeback billing in the Federal Government and NASA for the last 10 years. The Federal Government's chargeback billing costs have continued to rise each year with the sharpest increases occurring since 1988. From 1988 to 1993, the chargeback billing costs for all Federal Agencies increased by 60% from $1.1 billion to $1.76 billion. NASA's chargeback billing costs stabilized at around $5 million annually during the 1980's but has recently begun to increase as well. In comparison, NASA's chargeback billing costs have increased 25% since 1988. In general, the spiraling cost of health care is considered to be one of the major factors in the rising trend of chargeback billing.

* Does not include loss of the Mars Observer spacecraft.

TOTAL COSTS TO NASA DUE TO MISHAPS
CHARGEBACK VS. ALL OTHER COSTS



* DOES NOT INCLUDE LOSS OF MARS OBSERVER - $250 MILLION

Figure 9

HISTORY OF CHARGEBACK BILLING COSTS FOR ALL FEDERAL AGENCIES AND NASA (IN MILLIONS OF DOLLARS)

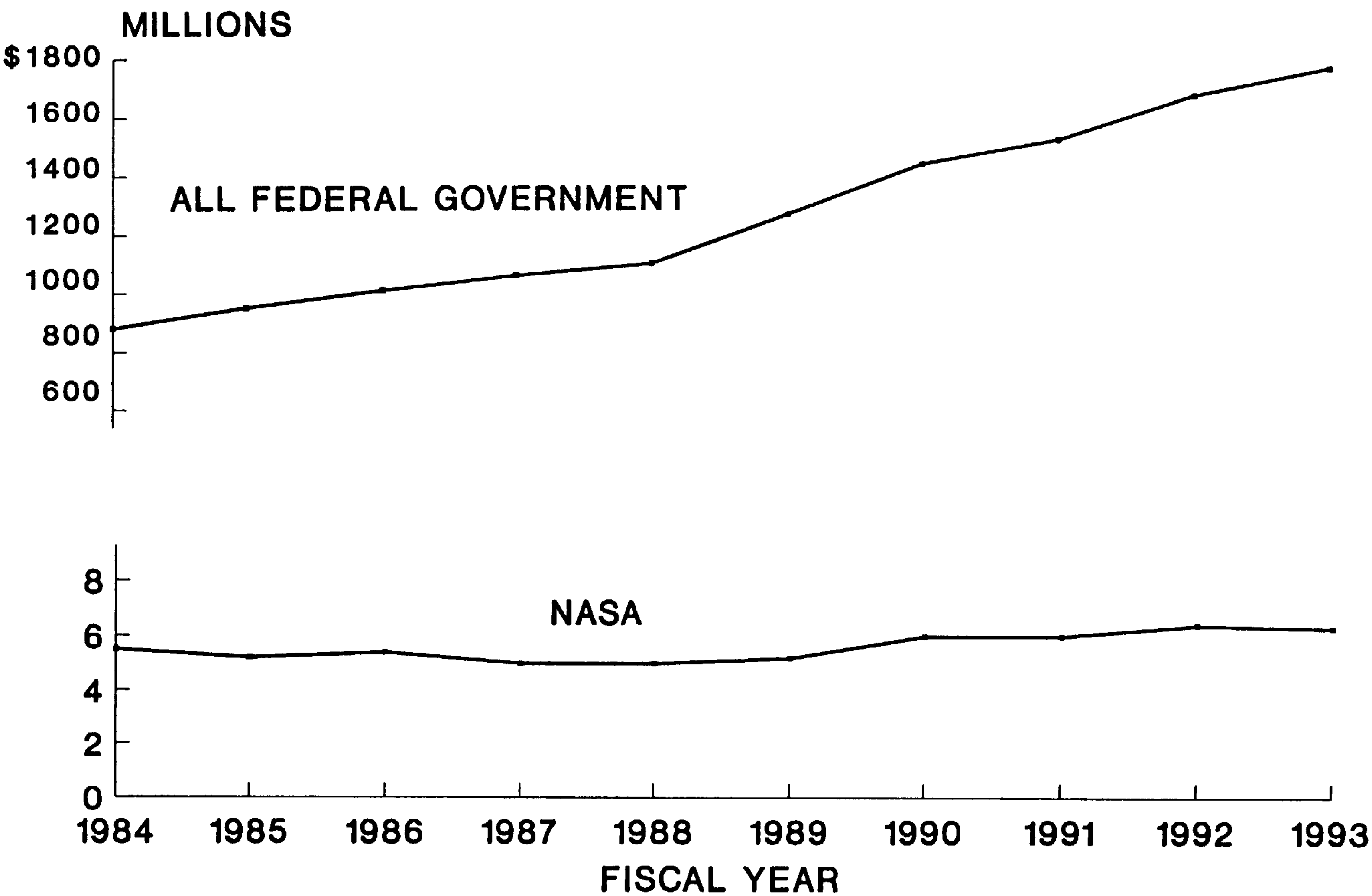


Figure 10

MATERIAL LOSSES

Tables 2A and 2B list the statistics for NASA material losses during FY 1993. Indirect costs associated with cleanup, investigation, injuries, or shutdown of operations are not included in these statistics.

Table 2A provides the number of equipment/property damage cases by equipment classification for each Center.

Table 2B provides the cost of equipment/property damage cases by equipment classification for each Center. Cost due to the loss of the Mars Observer spacecraft is not included in Table 2B. The value of Mars Observer (equipment only) is estimated at $250 million. See Page 32 for further details.

Figure 11 provides a percentage breakdown of equipment/property costs for FY 1993. The major contributors were facility-related costs due primarily to the loss of a main electrical transformer at SSC when overhead power lines were struck by lightning (see Page 32 for further details).

Figure 12 illustrates the total costs of material losses over the last 5 years.

Figure 13 categorizes NASA's total equipment/property costs due to mishaps for the last 5 years from 1989 to 1993. Damage/loss of flight hardware was the number one contributor to NASA's material losses during that period. Even when not considering the loss of the Mars Observer spacecraft, 62% of NASA's material losses were flight hardware related. Mishaps resulting in damage to NASA facilities were the second most costly. Approximately 22% of NASA's material losses during the last 5 years are attributed to facility damage.

TABLE 2A. EQUIPMENT/PROPERTY DAMAGE BY INSTALLATION - ANNUAL REPORT FY 1993
NUMBER OF CASES BY EQUIPMENT CLASSIFICATION

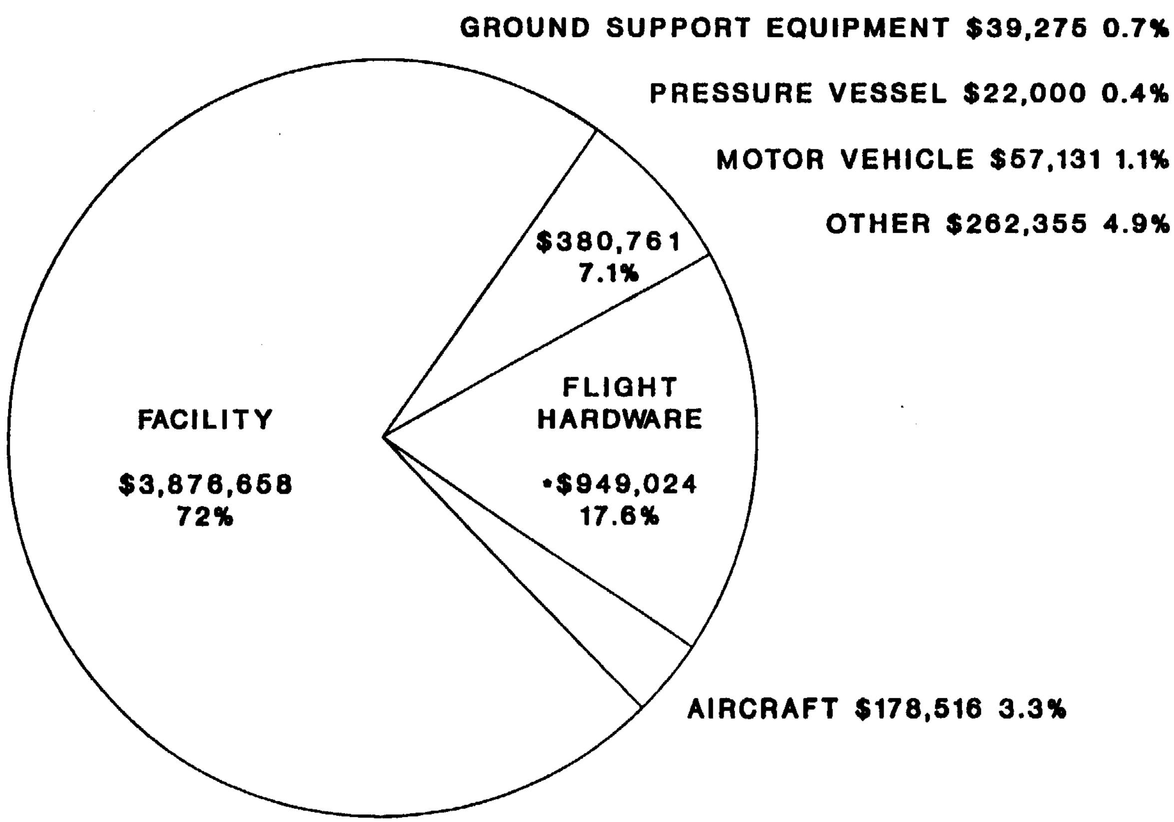
	Flight Hardware	Ground Support Equip.	Facility	Pressure Vessel	Motor Vehicle	Aircraft	Other	Total Cases
ARC/DFRF	0	0	0	0	0	0	0	0
GSFC/WFF	1	1	0	0	1	0	1	4
HQ	0	0	0	0	3	0	0	3
JPL	1	0	2	0	0	0	0	3
JSC/WSTF	2	1	1	1	0	3	5	13
KSC	14	4	4	0	14	1	1	38
LARC	0	0	2	0	1	1	2	6
LERC	1	0	7	1	2	0	10	21
MSFC	4	0	3	0	2	0	12	21
SSC	0	0	1	0	0	0	0	1
TOTAL	23	6	20	2	23	5	31	110
1992	39	9	26	3	7	2	16	102

TABLE 2B. EQUIPMENT/PROPERTY COSTS BY INSTALLATION - ANNUAL REPORT FY 1993
COST OF CASES BY EQUIPMENT CLASSIFICATION

	Flight Hardware	Ground Support Equip.	Facility	Pressure Vessel	Motor Vehicle	Aircraft	Other	Total Costs
ARC/DFRF	0	0	0	0	0	0	0	0
GSFC/WFF	250,000	5,000	0	0	1,200	0	25,000	281,200
HQ	0	0	0	0	4,656	0	0	4,656
JPL	*	0	54,774	0	0	0	0	* 54,774
JSC/WSTF	130,000	30,000	275	7,000	0	125,216	5,920	298,411
KSC	416,846	4,275	14,883	0	42,245	3,300	1,900	483,449
LARC	0	0	27,400	0	850	50,000	1,750	80,000
LERC	50,000	0	641,600	15,000	3,600	0	40,903	751,103
MSFC	102,178	0	12,726	0	4,580	0	186,882	306,366
SSC	0	0	3,125,000	0	0	0	0	3,125,000
TOTAL	* 949,024	39,275	3,876,658	22,000	57,131	178,516	262,355	* 5,384,959
1992	6,961,827	134,697	530,169	15,338	15,338	45,497	344,730	8,038,020

* Does not include loss of the Mars Observer spacecraft. The value of Mars Observer (equipment only) is estimated at $250 million. See Page 32 for further details.

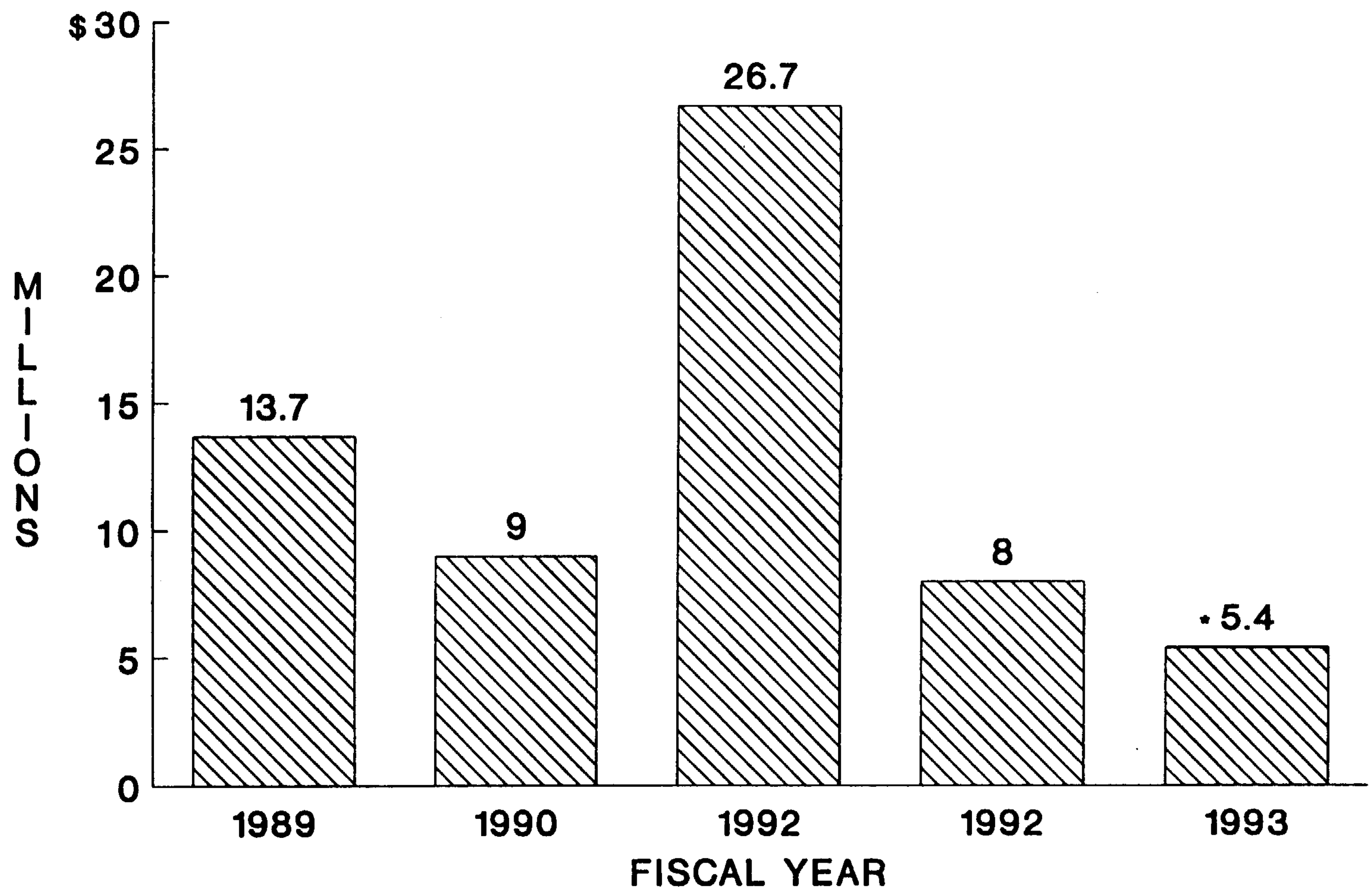
FY 1993 MATERIAL LOSSES DUE TO MISHAPS
NASA TOTAL *$5,384,959



* DOES NOT INCLUDE LOSS OF MARS OBSERVER - $250 MILLION

Figure 11

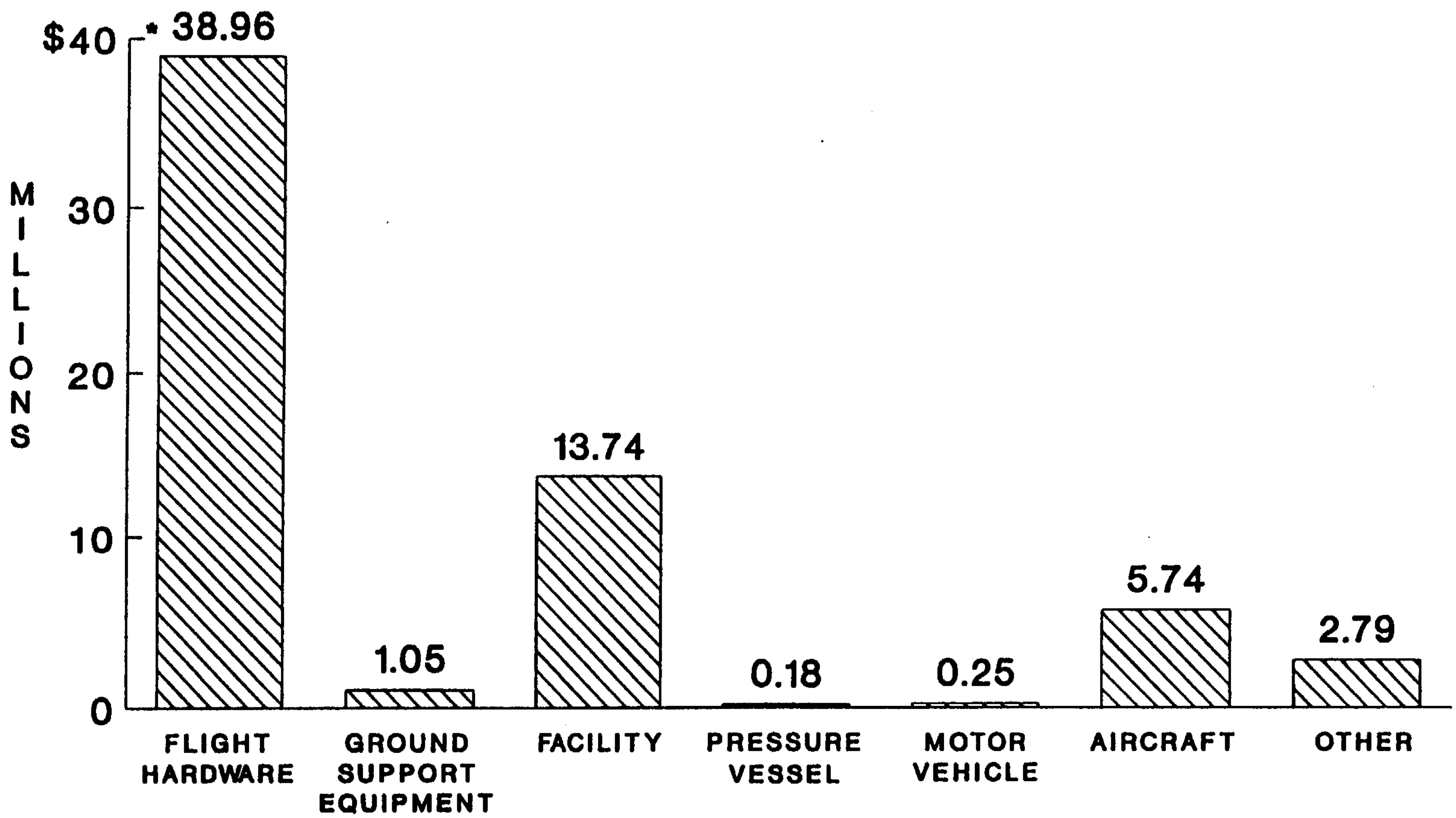
NASA MATERIAL LOSSES DUE TO MISHAPS
TOTAL COSTS



* DOES NOT INCLUDE LOSS OF THE MARS OBSERVER SPACECRAFT - $250 MILLION

Figure 12

NASA MATERIAL LOSSES DUE TO MISHAPS
CATEGORY TOTALS
FY 1989 - FY 1993



* DOES NOT INCLUDE LOSS OF THE MARS OBSERVER SPACECRAFT - $250 MILLION

Figure 13

NASA MISHAP DEFINITIONS

The revised NASA Management Instruction for Mishap Reporting and Investigation (NMI 8621.1F), dated December 31, 1991, contains updated NASA mishap definitions. All mishaps reported in FY 1993 were categorized according to these definitions as follows:

1. **NASA MISHAP:** Any unplanned occurrence, event, or anomaly that meets one of the definitions below. Injury to a member of the public while on NASA facilities also is defined as a NASA mishap.

    a. **TYPE A MISHAP:** A mishap causing death and/or damage to equipment or property equal to or greater than $1,000,000. Mishaps resulting in damage to aircraft or space hardware, i.e., flight and ground support hardware, meeting these criteria are included. This definition also applies to a test failure if the damage was unexpected or unanticipated or if the failure is likely to have significant program impact or visibility.

    b. **TYPE B MISHAP:** A mishap resulting in permanent disability to one or more persons, or hospitalization (for other that observation) of five or more persons, and/or damage to equipment or property equal to or greater than $250,000 but less than $1,000,000. Mishaps resulting in damage to aircraft or space hardware which meet these criteria are included, as are test failures where the damage was unexpected or unanticipated.

    c. **TYPE C MISHAP:** A mishap resulting in damage to equipment or property equal to or greater than $25,000 but less than $250,000, and/or causing occupational injury or illness that results in a lost workday case. Mishaps resulting in damage to aircraft or space hardware which meet these criteria are included, as are test failures where the damage was unexpected or unanticipated.

    d. **MISSION FAILURE:** Any mishap (event) of such a serious nature that it prevents accomplishment of a majority of the primary mission objectives. A mishap of whatever intrinsic severity that, in the judgment of the Program Associate Administrator, in coordination with the Associate Administrator for Safety and Mission Quality (now Safety and Mission Assurance), prevents the achievement of primary mission objectives as described in the Mission Operations Report or equivalent document.

    e. **INCIDENT:** A mishap consisting of less than Type C severity of injury to personnel (more than first aid severity) and/or property damage equal to or greater than $1,000 but less than $25,000.

2. **NASA CONTRACTOR MISHAP:** Any mishaps as defined in Paragraphs 1a through 1e that involve only NASA contractor personnel, equipment, or facilities in support of NASA operations.

3. **IMMEDIATELY REPORTABLE MISHAPS:** All mishaps that require immediate telephonic notification to local and Headquarters safety officials. Included in this category are those mishaps defined in Paragraphs 1a through 1d and 2 with the exception of Type C injury/illness cases and incidents.

4. **CLOSE CALL:** An occurrence in which there is no injury, no significant equipment/property damage (less than $1,000), and no significant interruption of productive work, but which possesses a high potential for any of the mishaps as defined in Paragraphs 1a through 1e.

5. **OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) RECORDABLE MISHAP:** An occupational death, injury, or illness that must be recorded subject to OSHA requirements in 29 CFR Parts 1960 and 1910.

6. **COSTS:** Direct costs of repair, retest, program delays, replacement, or recovery of NASA materials including hours, material, and contract costs, but excluding indirect costs of cleanup, investigation (either by NASA, contractor, or consultant), injury, and by normal operational shutdown. Materials or equipment replaced by another organization at no cost to NASA will be calculated at "book" value. This includes those mishaps covered by insurance.

MISHAP STATISTICS

Tables 3 and 4 show the number of mishaps that were reported by the NASA Centers as having significance beyond the minor dollar losses or no-lost time injury category. These mishaps provide lessons learned for all NASA accident prevention programs.

Table 3 shows the number of fatalities experienced by NASA over the last 5 years categorized by Center. NASA experienced no mishap-related fatalities during FY 1993.

Table 4 shows the number of Type A, B, and C mishaps over the last 5 years.

Figure 14 presents a 5-year overview of all NASA Type A and B mishaps and Type C property damage mishaps. Type B and C personal injuries are reflected in Table 1.

Tables 5A and 5B provide a safety performance summary for FY 1993. Table 5A compares FY 1993 lost time injury/illness rates with each Center's goal and previous performance. Table 5B shows the number and type of mishaps and the cost of material losses for FY 1992 and FY 1993.

TABLE 3. FATALITIES - ANNUAL REPORT FY 1992

	1989	1990	1991	1992	1993
	N/ C/ O*	N/ C/ O	N/ C/ O	N/ C/ O	N/ C/ O
ARC/DFRF	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0
GSFC/WFF	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0
HQ	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0
JPL	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0
JSC/WSTF	0/ 0/ 0	0/ 0/ 0	0/ 0/ 1	0/ 0/ 0	0/ 0/ 0
KSC	0/ 1/ 0	0/ 0/ 1	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0
LARC	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	1/ 0/ 0	0/ 0/ 0
LERC	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0
MSFC/MAF	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0
SSC	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0
TOTAL	0/ 1/ 0	0/ 0/ 1	0/ 0/ 1	1/ 0/ 0	0/ 0/ 0

* N/ C/ O = NASA / Contractor / Other.

TABLE 4. NASA MAJOR MISHAPS BY INSTALLATION - ANNUAL REPORT FY 1992

	1989	1990	1991	1992	1993
	A/ B/ C	A/ B/ C	A/ B/ C	A/ B/ C	A/ B/ C
ARC/DFRF	1/ 0/ 19	1/ 1/ 14	1/ 2/ 12	0/ 0/ 16	0/ 0/ 21
GSFC/WFF	0/ 0/ 8	0/ 0/ 11	0/ 0/ 9	0/ 0/ 14	0/ 1/ 10
HQ	0/ 0/ 8	0/ 0/ 18	0/ 0/ 17	0/ 0/ 21	0/ 0/ 7
JPL	0/ 1/ 0	0/ 0/ 1	0/ 0/ 1	0/ 1/ 1	1/ 0/ 1
JSC/WSTF	0/ 2/ 12	0/ 0/ 12	0/ 1/ 13	0/ 0/ 15	0/ 0/ 13
KSC	0/ 1/ 17	1/ 0/ 11	1/ 0/ 8	0/ 0/ 11	0/ 0/ 8
LARC	1/ 0/ 16	0/ 0/ 8	0/ 0/ 8	0/ 0/ 9	0/ 0/ 9
LERC	0/ 1/ 16	0/ 0/ 13	0/ 0/ 11	0/ 0/ 16	0/ 1/ 9
MSFC/MAF	0/ 1/ 18	0/ 0/ 11	1/ 0/ 20	1/ 3/ 26	0/ 0/ 16
SSC	0/ 0/ 0	0/ 0/ 1	0/ 0/ 1	0/ 0/ 1	1/ 0/ 2
TOTAL	2/ 6/114	2/ 1/100	3/ 3/100	1/ 4/130	2/ 2/ 96

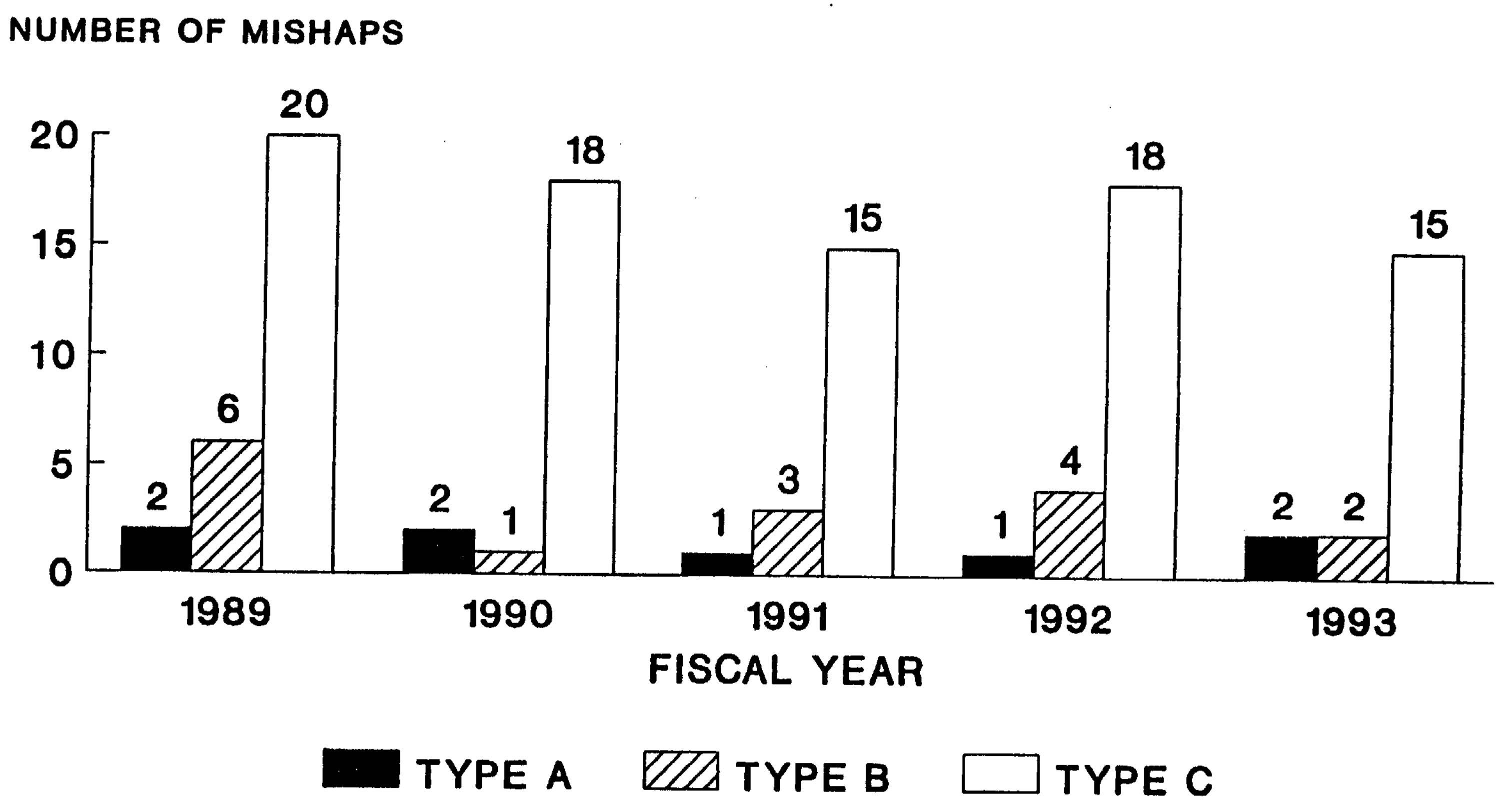
Includes NASA fatalities, permanent disabilities, hospitalization of 5 or more persons, lost time mishaps and Type A, B, & C property damage according to NMI 8621.1F.

NASA TYPE A, B, AND C MISHAPS

TYPE A: $1M OR GREATER

TYPE B: LESS THAN $1M BUT GREATER THAN $250K

TYPE C: LESS THAN $250K BUT GREATER THAN 25K



LOST TIME INJURIES ARE NOT INCLUDED.

Figure 14

TABLE 5A. PERFORMANCE SUMMARY - ANNUAL REPORT FY 1993

NASA LOST TIME RATES

	1992	GOAL 1993	1993
ARC/DFRF	0.63	0.51	0.89
GSFC/WFF	0.39	0.37	0.28
HQ	1.00	0.66	0.30
JSC/WSTF	0.39	0.36	0.27
KSC	0.33	0.34	0.21
LARC	0.32	0.35	0.26
LERC	0.54	0.43	0.30
MSFC/MAF	0.46	0.39	0.35
SSC	0.00	0.34	0.84
NASA	0.48	0.40	0.35

TABLE 5B. PERFORMANCE SUMMARY - ANNUAL REPORT FY 1993

	TYPE A MISHAPS			TYPE B MISHAPS		TYPE C MISHAPS		MATERIAL LOSSES	
	1992	1993	(FATALITIES) 1993	1992	1993	1992	1993	1992	1993
ARC/DFRF	0	0	0	0	0	16	21	189,234	0
GSFC/WFF	0	0	0	0	1	14	10	3,775	281,200
HQ	0	0	0	0	0	21	7	1,255	4,656
JPL	0	1	0	1	0	1	1	411,600	* 54,774
JSC/WSTF	0	0	0	0	0	15	13	66,887	298,411
KSC	0	0	0	0	0	11	8	263,642	483,449
LARC	0	0	0	0	0	9	9	20,641	80,000
LERC	0	0	0	0	1	16	9	115,965	751,103
MSFC/MAF	1	0	0	3	0	26	16	6,926,441	306,366
SSC	0	1	0	0	0	1	2	38,580	3,125,000
TOTALS	1	2	0	4	2	130	96	8,038,020	* 5,384,959

* Does not include loss of the Mars Observer spacecraft. The value of Mars Observer (equipment only) is estimated at $250 million. See Page 32 for further details.

MAJOR MISHAPS

FY 1993

MARS OBSERVER MISSION FAILURE
JET PROPULSION LABORATORY
TYPE A

All contact with the Mar Observer spacecraft was lost on August 21, 1993. The spacecraft was in the process of pressurizing a propellant tank in preparation for Mars orbit insertion. The most probable cause of the mishap is equipment failure due to material failure. Cost of the Mars Observer spacecraft (equipment only) is estimated at $250 million. Total program costs approach $1 billion.

MAIN ELECTRICAL POWER SUBSTATION STRUCK BY LIGHTENING
STENNIS SPACE CENTER
TYPE A

The main electrical power substation at SSC was damaged on January 24, 1993, during a severe thunder storm that passed over the southern most portion of Center. At approximately 5:56 a.m., three pole-mounted transformers at the north end of the Center failed and their insulators shorted. Event activity indicated lightning strikes on the overhead power lines. The Center lost all power at 6:01 a.m. The primary cause of the mishap was the natural phenomenon of lightning. Equipment design and operational procedure deficiencies contributed to the extent of damage. Final cost of the mishap was $3,125,000.

CENTRAL AIR SYSTEM COMPRESSOR BEARING FAILURE
LEWIS RESEARCH CENTER
TYPE B

A second-phase bearing assembly and housing on a 450-psi air compressor failed catastrophically on July 21, 1993 at 4:00 a.m. The mishap occurred during an unscheduled start of some remotely operated equipment. The primary cause of the mishap was equipment failure due to a design deficiency. Material failure due to defects was a contributing factor. Final cost of the mishap was $500,000.

SCIENTIFIC BALLOON PAYLOAD MISHAP
GODDARD SPACE FLIGHT CENTER
TYPE B

A fire occurred on September 30, 1993, during termination of a NASA scientific balloon flight after the conclusion of a successful mission. The experimental payload, suspended beneath a recovery parachute, descended to an area approximately 10 miles south west of Woodward, Oklahoma, under gusting wind conditions. Upon landing, the payload and the parachute were blown into some rural power lines. Contact of the payload/parachute system with the power lines resulted in a brush fire. The payload experienced extensive fire damage and 20 - 30 acres of fallow land were burned before the local volunteer fire department was able to extinguish the fire. The primary cause of the mishap was the natural phenomenon of wind. Misjudgment of the weather conditions by mission personnel was a contributing factor. Final cost of the mishap was $250,000.

TYPE C MISHAPS
EQUIPMENT/PROPERTY DAMAGE

Jet Propulsion Laboratory

A pump room and a number of sensors, gauges, and switches were damaged when sewage overflowed a wet well and filled the room. The primary cause of this mishap was determined to be a procedural deficiency. No action was taken on the previous day when an alarm signal indicated that the sewer pump effluent pressure had dropped below 100 gallons per minute. Final cost of the mishap was $51,774.

Johnson Space Center

Damage to a NASA T38-A aircraft engine turbine blade was noted during a preflight inspection. Because of this finding, all NASA T38 aircraft were inspected and similar damage was noted on three additional engines. In all cases, a rivet was missing from the outer shell of the combustion basket at the ignition ferrule. The turbine blade damage was most likely caused by the loose rivet striking the blades during operation. The primary cause of the mishap was equipment failure due to material failure. Final cost of the mishap was $104,259.

During processing of three Extravehicular Mobility Unit batteries, the intercell leakage test indicated that electrolyte was leaking to ambient. Investigation revealed that a recent change in the method of battery formation and corresponding ground support equipment modifications resulted in no pressure relief capability for the batteries while they were being charged. Internal pressure during charging exceeded cell integrity. The primary cause of the mishap was inadequate task coordination and planning. Final cost of the mishap was $60,000.

Johnson Space Center (continued)
A Space Shuttle computer shared, local memory controller experienced an extended burn-in overhead due to a faulty power connection caused by corrosion buildup. The primary cause of the mishap was equipment failure due to material failure. Final cost of the mishap was $30,000.

A Space Shuttle refrigerator/freezer secondary containment was inadvertently overpressurized resulting in failure of the pressure system. Metal surrounding the retaining bolts on the back end plate failed allowing the end plate to come loose and cause extensive damage to the unit structure, subassemblies, and sheet metal components. The primary cause of the mishap was deviation from proper handling procedures. Lack of training was a contributing factor. Final cost of the mishap was $70,000.

Kennedy Space Center
A Freon system loop pump package on Space Shuttle Orbiter Endeavour sustained damage when it was inadvertently overpressurized. The primary cause of the mishap was misconfiguration of equipment due to a procedural deficiency. The cost of damage was estimated at $244,000.

A release of N_2O_4 oxidizer occurred while removing a hypergolic quick disconnect flight cap in the Orbiter Processing Facility at KSC. The primary cause of the mishap was equipment failure due to material failure. Final cost of the mishap was $73,000.

A Space Shuttle Power Reactant Storage and Distribution System tank fitting was found to be bent. The primary cause of the mishap was inadequate task coordination and planning. Cost of the mishap was estimated at $50,000.

Langley Research Center
A NASA T-34C aircraft performed a gear-up landing on September 9, 1993, at the Newport News/Williamsburg airport in Virginia. The plane sustained damage to the propeller and spinner. The primary cause of the mishap was deviation from proper procedure. Final cost of the mishap was $50,000.

A lifting body configuration model was damaged while being tested in the 31-Inch Mach 10 wind tunnel at LaRC. A sliding cover plate mounted to the Flow Field Survey Probe (FFSP) came loose and struck the model. There were five screws used to attach the plate to the FFSP. The heads broke off three of the screws and the other two screws pulled loose. The primary cause of the mishap was equipment failure due to a design deficiency. Material failure and inadequate maintenance were contributing factors. Final cost of the mishap was $27,000.

Lewis Research Center
A J-85-21 turbojet engine was damaged during testing. After approximately 30 hours of testing, the engine's lubrication system malfunctioned. Final cost of the mishap was $50,000.

Marshall Space Flight Center
Approximately 5,000 gallons of sulfuric acid leaked from a storage tank. Fractures on the surface of the tank indicated that it cracked as a result of an impact load that may have occurred during manufacturing, transportation, or installation. Final cost of the mishap was $25,000.

A Space Shuttle Main Engine main combustion chamber was damaged during manufacturing. While electron beam welding the combustion chamber's two jacket halves, the servo drive for the y-axis travel motor stopped approximately halfway through the weld. A borescope inspection of the underlying coolant channel revealed electron beam penetration into the channel and impingement onto the opposing wall. The primary cause of the mishap was equipment failure due to inadequate maintenance. Final cost of the mishap was $27,000.

Experimental Environmental Control and Life Support System bellows assembly and unibed were subjected to possible water damage. The two units were being temporarily stored in a clean room that flooded due to the malfunction of a domestic water line. The units had to undergo a drying and electrical function checkout process. Primary cause of the mishap was equipment failure due to material failure. Final cost of the mishap was $51,511.

A Space Shuttle Main Engine spark igniter was being handled when it fell to the floor and the Lucite protective closure shattered. As a result, the igniter failed functional tests and had to be scrapped. The primary cause of the mishap was personnel lack of attention. A handling design deficiency was a contributing factor. Final cost of the mishap was $25,507.